



CRC for Construction Innovation. *Best Practice Guide : Subcontractors.*



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Best Practice Guide: Subcontractors

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Critical Success Factors for Organisations in Information and Communication Technology-Mediated Supply Chains**

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Leaders in Construction and Property Research

Who should read this Guide?

This Guide would be of interest to anyone engaged in subcontracting (trade or specialist) within the construction industry and who wished to better understand the issues that influenced the effective use of Information and Communication Technologies (ICT) within their business. *However, it is structured to meet the specific needs of those charged with responsibility for making ICT investment decisions within a firm, such as senior board members or ICT managers.* It recognises that some readers may be experienced, high-level ICT users whilst others could well be looking for guidance as to how best to ramp up their ICT use beyond a basic level. Accordingly this guide is structured to provide value to high-, medium- and low-level ICT users.

What does this Guide contain?

The Guide contains the distilled findings from a major, two-year research project to explore those factors considered by industry practitioners to be critical to the successful adoption of ICT, both within their firms and between their firms and their trading partners. In the context of this project Critical Success Factors (CSFs) have been defined as,

“Those things that absolutely, positively must be attended to in order to maximise the likelihood of a successful outcome for the stakeholder, defined in the stakeholder’s terms.”

The guide includes:

- Perceived benefits of ICT use across the subcontractors’ sector
- Types and levels of ICT used across the sector
- Self-assessment tool
- CSFs for medium- and high-level ICT users, including
 - Best Practice Profiles
 - Action Statements
- Barriers to ICT use for low-level users
 - Action Statements

The material contained in this Guide has been generated following a number of principles:

- For a given situation there is not a single ‘right answer’, but a number of solutions that have to be evaluated using a range of relevant factors.
- As there are as many solutions as there are ‘solvers’, factors for evaluation will ‘emerge’ from collective wisdom.

How should this Guide be used?

You should already be aware that there are issues that influence the way in which you engage with ICT in your organisation. Some of these issues are internal and can be directly influenced by your decisions. Others are external and the extent to which you can influence them is determined by a combination of your size and position in the industry. Indeed, some are of such a magnitude that they are effectively outside the control or influence of any single organisation. Nevertheless, you will recognise the need to make decisions about the use of ICT in project situations on the basis of the best possible information.

In order to understand this further a useful concept used throughout this guide is that of a 'supply chain'. For the purposes of this guide we have defined this as,

"A group of construction industry participants that have come together in order to complete a project....."

In the event that some, or this entire group wish to use some measure of ICT the following can be added:

".....within which ICT is used to facilitate intra- and/or inter-organisational communication and information flows."

We believe that it is increasingly likely that your organisation will operate in such a supply chain and that, depending upon your current experience with ICT you will find it advantageous to identify and understand the most important issues that face you. Therefore, the first part of this guide will help you identify where your current use of ICT places you within the spectrum of construction industry users. It consists of a simple self-assessment task, and will place your organisation within one of three categories of user.

If you find that you are a low-level ICT user you will be directed to a section that explores the barriers that others in your position have experienced. You will be asked to respond to a few questions and record your responses. These will then enable you to gauge the extent to which your decisions concerning ICT investments and implementation are affected by these barriers. There are then a range of other issues, some of which you might or might not have considered that could affect the outcome of your ICT decisions. In each case strategies are suggested that could help you overcome the barriers.

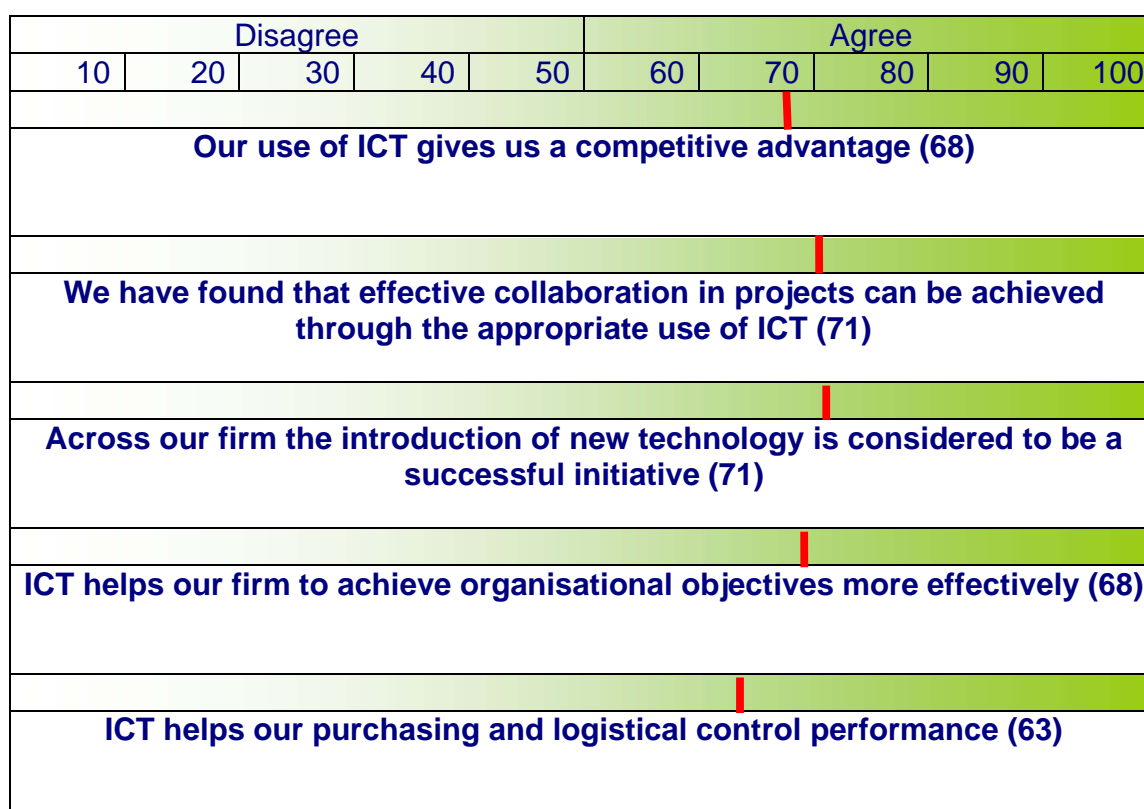
If you find that you are a medium- or high level ICT user you will be directed to a section that explores the factors that others in your position have found to be critical to their successful implementation of ICT. You also will be asked to respond to a few questions and record your responses. These are dealt with in two questionnaires that cover:

- Your personal attitudinal response to ICT issues
- Your firm's current ICT posture

These will enable you to gauge how both you and your organisation are performing in the critical success areas, and to gauge where you stand in comparison to the rest of the industry.

What are the perceived benefits gained from the use of ICT within subcontracting firms?

This section provides you with an overview of the attitudes and experiences of other subcontracting firms sampled from across the industry. Subcontractors, both trade and specialist, from around the country were asked to what extent they agreed or disagreed with each statement. The figures therefore represent the extent to which all types of subcontractor agreed with each statement and can be thought of as being indicative of the experiences of your peers when using ICT in their businesses.



What are the types and level of ICT used in the industry?

It is useful for you to understand what others in the construction industry are investing in and using in their everyday work, and at what level they believe that they are operating when they consider their ICT usage. In order to provide an indication of this all of the industry practitioners surveyed were asked to flag all of the ICT tools that they used. Following the findings of previous research the following technologies were identified and level definitions adopted:

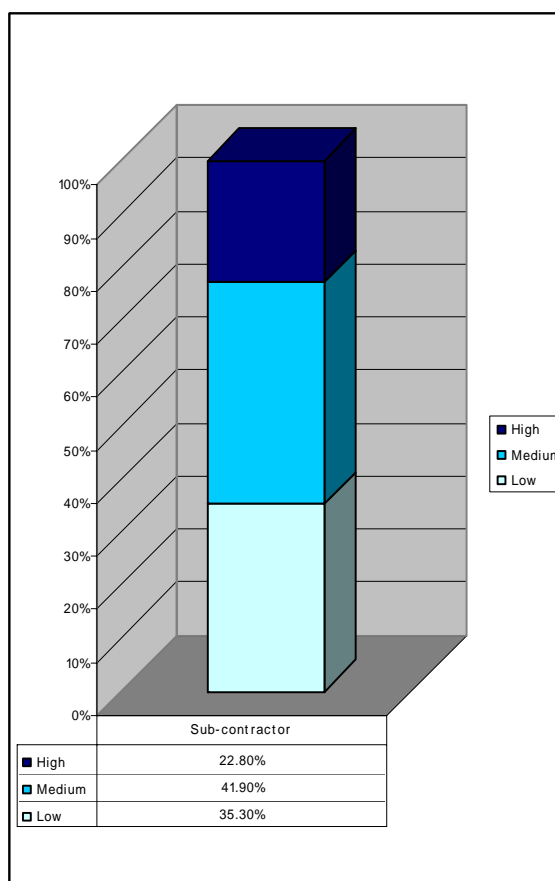
ICT Tools and Levels			
High Level ICT	Medium Level ICT	3D/4D modeling and virtual reality/ Virtual communication	Integration
		Own web server/project collaboration/logistics tool	
		ERP (Enterprise Resource Planning) system across organisation and projects	
		Integrated design and construction management software system	
	Low Level ICT	Web based project collaboration (for design or construction)	Communication
		Internet (company web page and for information access)	
Medium Level ICT	Low Level ICT	Email*	Automation
		Networked PC/Shared database (word processing/spreadsheet/simple database)	
		Stand alone PC	
		Mobile phone	
Low Level ICT	Low Level ICT	Fax	
		Land phone	

** It is significant to note that the responses from across all industry sectors indicate that, whilst the type of communication enabled by email may have the characteristics of a medium-level technology, it is no longer regarded as such by industry participants. It is now rated as belonging to the set of tools identified as low-level, and is an essential element of communication capability across all construction industry sectors.*

To understand which part of the Guide will be most useful to you simply identify which of the above technologies you currently use. If they are all contained within the light blue, low-level zone then you should look first at the barriers section on page 28 once you have finished reading pages 6-10. Otherwise you should read this guide in sequence.

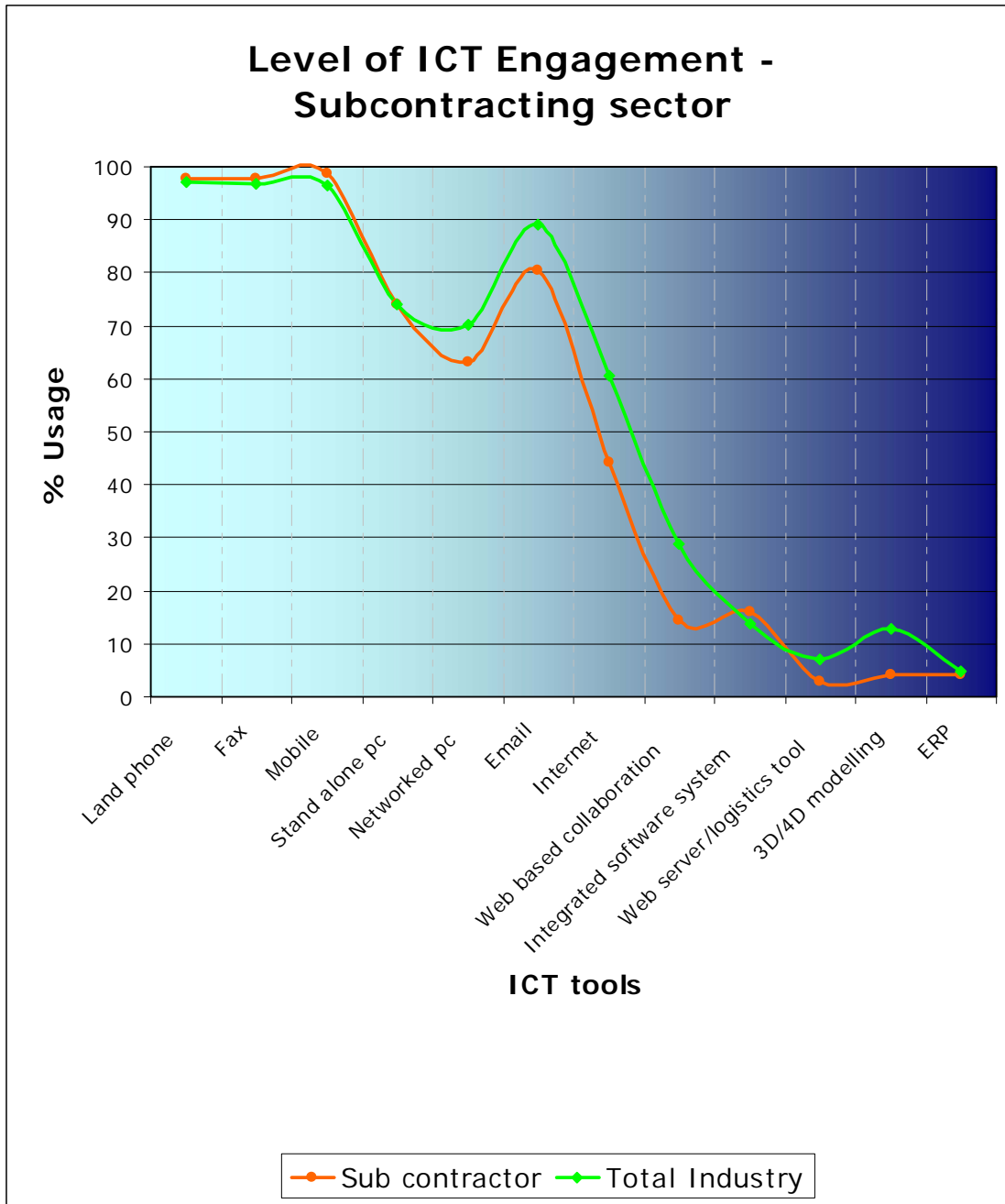
What is the level of ICT use across the subcontracting sector?

Using this information you can now see the spread of ICT use in the subcontracting sector:



What specific tools do subcontractors use?

The following graph shows the type of ICT tools and the extent to which they are used in the sub-contracting sector.



Critical Success Factors for the use of ICT within, and between firms engaged in construction projects: Guidance for medium- and high-level ICT users.

At this level you are most likely to be concerned maximising the return on your investment in new technology. The following Critical Success Factors have all been identified from the responses to the national survey as being of primary significance in the drive for successful ICT implementation:

- Organisational Commitment
- Support and Assurance
- Rights and Duties
- Organisational Attitude
- Investment Drive, and
- Communication Structure

As a medium-level ICT user you will be most likely be concerned with developing strategies that will take you to a higher level of use and performance. This will probably involve you in deciding which of the available technologies mesh best with those of your trading partners.

As a high-level ICT user technology may well be of less concern to you than developing strategies that encourage your supply chain to engage more fully with your chosen technologies.

The itemised Success Factors are grouped as follows:

- Organisational Commitment
 1. The commitment of an organisation's employees is vital to the successful adoption and use of ICT.
 2. An organisation's continuous and conspicuous investment in staff development and training is vital to its successful adoption and use of ICT.
 3. Successful ICT implementation requires the commitment of a firm's senior management.
 4. Transparency and trust among project team participants is vital for the successful adoption of ICT across a project team.
- Support and Assurance
 5. The security of information is vital in an ICT-enabled project environment.
 6. A "champion" should support all new technology that is to be used across a project team within a firm.
- Rights and Duties
 7. The identification of the ownership of the intellectual property generated during a project is a significant issue affecting the adoption of ICT across a project team.
 8. Project team members must acknowledge the sensitivity and confidentiality of other participants' information.
 9. Project teams require a powerful ICT "champion" to support the technologically weaker organisations in order to ensure that communication processes continue to function as planned.
- Organisational Attitude
 10. The availability of standard conditions of contracts that specifically accommodate the issues raised by the use of ICT will encourage the use of these technologies for project communications.
 11. When using ICT for project communications an organisation needs to be prepared to engage in long-term collaborative relationships, such as partnering.
- Investment Drive
 12. Organisations commit to ICT as a long-term, strategic decision.
 13. Competitor adoption is the most powerful trigger for the adoption of ICT
 14. Organisations commit to ICT as a project-based, tactical decision.
- Communication Structure
 15. Organisations try to limit their use of multiple online systems promoted by different project participants.
 16. A fragmented project team will lead to the ineffective performance of ICT-enabled operations

For each of the Success Factors there is a Best Practice Profile together with a set of Action Statements based on a series of case studies of firms engaged in ICT-mediated project teams.

Please note that there are three issues that have been revealed to be of some significance but that fall outside of the sphere of influence of the individual organisation, namely the development of industry-wide standards, standard forms of contract that incorporate issues specific to the use of ICT, and government leadership in the

encouragement of ICT-enabled performance improvement across the construction industry. In terms of individual firms, the implications of these issues are probably limited to increased involvement in lobby/special interest pressure groups, and as such fall outside the scope of this guide.

This tool is designed to help you assess two things. Firstly it examines your personal attitudes to the Success Factors. Secondly it allows you to assess your firm's current position in relation to the Success Factors. Therefore, to use this section using to its fullest extent you should respond to the following two questionnaires and record your responses in the spaces provided. These values should then be compared to the graphs for each Critical Success Factor. This will show how both your personal attitudinal attributes and your firm's characteristics compare to the rest of the sector and thus indicate the areas in which you might concentrate your efforts. For a fuller analysis these pages should be read in conjunction with your completed data entered into the spreadsheet and charts contained on the accompanying CD.

CSF Self-Assessment Tool: Personal Attitude

Please indicate the extent to which you personally agree or disagree with each of the following statements, using a scale between 0 (totally disagree) and 100 (totally agree).

Fact or No.	Statement	Factor	Your Rating
1	The commitment of an organisation's employees is vital to the successful adoption and use of ICT.	Organisational commitment	
2	An organisation's continuous and conspicuous investment in staff development and training is vital to its successful adoption and use of ICT.	Organisational commitment	
3	Successful ICT implementation requires the commitment of a firm's senior management.	Organisational commitment	
4	Transparency and trust among project team participants is vital for the successful adoption of ICT across a project team.	Organisational commitment	
5	The identification of the ownership of the intellectual property generated during a project is a significant issue affecting the adoption of ICT across a project team.	Rights and duties	
6	Project team members must acknowledge the sensitivity and confidentiality of other participants' information.	Rights and duties	
7	Project teams require a powerful ICT "champion" to support the technologically weaker organisations in order to ensure that communication processes continue to function as planned.	Rights and duties	
8	Organisations commit to ICT as a long-term, strategic decision.	Investment drive	
9	Organisations commit to ICT as a project-based, tactical decision.	Investment drive	
10	Competitor adoption is the most powerful trigger for the adoption of ICT.	Investment drive	
11	A fragmented project team will lead to the ineffective performance of ICT-enabled operations.	Communication structure	
12	The security of information is vital in an ICT-enabled project environment.	Support and Assurance	
13	A "champion" should support all new technology that is to be used across a project team within a firm.	Support and Assurance	
14*	The availability of standard conditions of contracts that specifically accommodate the issues raised by the use of ICT will encourage the use of these technologies for project communications.	Organisational attitude	
15	When using ICT for project communications an organisation needs to be prepared to engage in long-term collaborative relationships, such as partnering.	Organisational attitude	
* Factor 14 is not represented in the following tables as it cannot be controlled at the level of the individual firm.			
Key to factor impact level			
	High impact factor		
	Medium impact factor		
	Low impact factor		

Now enter these figures into the appropriate chart on the accompanying CD to discover your personal attitudinal strengths, weaknesses and ICT-readiness profile as compared to your peers.

CSF Self-Assessment Tool: Organisational Readiness

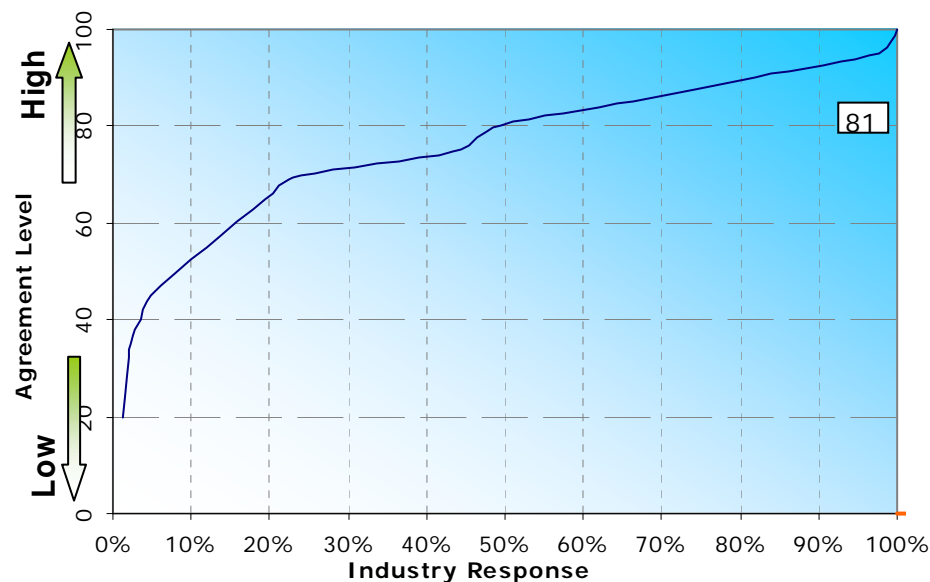
Please indicate the extent to which you feel that your firm displays the following attributes, using a scale between 0 (totally disagree) and 100 (totally agree)

Fact or No.	Statement	Factor	Organisation's Rating
1	Our employees are committed the use of ICT for diverse purposes in projects.	Organisational commitment	
2	Our firm continuously invests in staff development for ICT training	Organisational commitment	
3	Our senior management is committed to developing relationships with project team partners.	Organisational commitment	
4	We value transparency and trust in our relationships with project team partners.	Organisational commitment	
5	Our firm has a strong ethical stance that respects the intellectual property rights of others.	Rights and duties	
6	We protect the confidentiality of all commercially sensitive information provided by our project partners.	Rights and duties	
7	We believe that ICT "champions" within project teams have an obligation to support and nurture less ICT-capable team members.	Rights and duties	
8	Our firm commits to investment in ICT principally as a long-term, strategic decision.	Investment drive	
9	We are willing to commit to ICT as a project-based, tactical decision.	Investment drive	
10	Our firm tends to respond to, and match our competitor's ICT initiatives.	Investment drive	
11	We recognise that fragmented project teams tend to reduce the effectiveness of ICT in project situations.	Communication structure	
12	Our firm respects and protects the security of information in ICT transactions with trading partners.	Support and Assurance	
13	We recognise the need for ICT use in our firm to be "championed" by an individual.	Support and Assurance	
14*	We generally would like to use standard conditions of contract that incorporated ICT when engaging with project partners.	Organisational attitude	
15	We encourage long-term collaborative relationships with our project partners, such as partnering.	Organisational attitude	
* Factor 14 is not represented in the following tables as it cannot be controlled at the level of the individual firm.			
Key to factor impact level			
	High impact factor		
	Medium impact factor		
	Low impact factor		

Now enter these figures into the appropriate chart on the accompanying CD to discover your strengths, weaknesses and ICT-readiness profile as compared to the rest of the industry.

Critical Success Factor 1: Organisational Commitment

The commitment of an organisation's employees is vital to the successful adoption and use of ICT.



Best Practice Profile

For a high-level user it is probable that fairly sophisticated, formal procedures exist to obtain employee buy-in. These might include a rolling programme of staff development modules, either delivered in-house or outsourced from a specialist provider, and regular staff evaluation interviews to ascertain individual staff development needs. If 'high-level' also equates to 'large' then it is possible that without such a programme the senior management team would become unaware of rising issues at the coalface. Remember that those charged with operationalising organisational policy are often the first to recognise the onset of a problem and may often already be implementing ad-hoc measures to overcome it-capturing and acknowledging this kind of knowledge serves to empower the staff and demonstrate that you value their input, and as such encourages their engagement with the processes that you are championing.

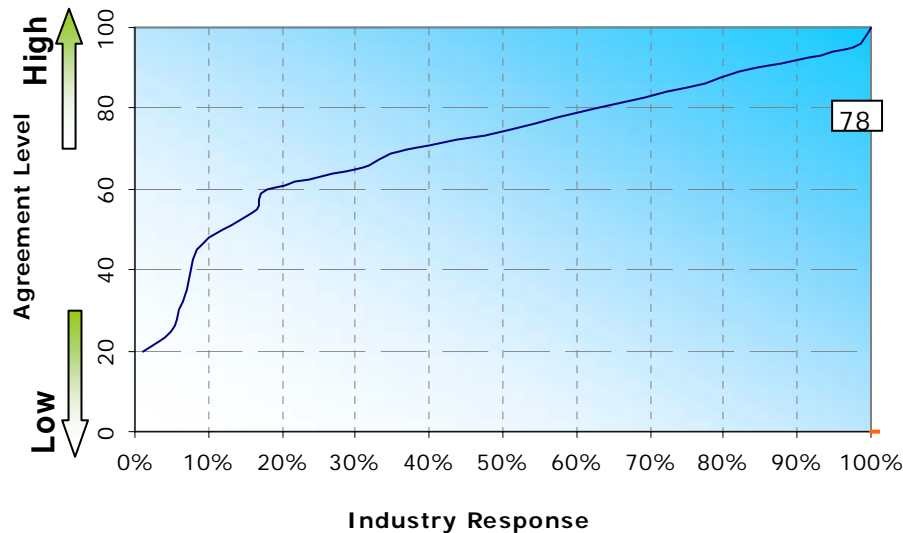
Similar issues face the medium-level user, although (possibly) smaller size and less power within the supply chain may well mean that staff are more heavily influenced by protocols dictated from outside the organisation. If this is the case then a responsive, reactive stance is required to support the increased pressures that they are likely to feel when meeting these kinds of challenge.

Action Statement

- Consult staff before, and during ICT adoption initiatives.
- Form working parties that include representation from all stakeholder groups likely to be impacted by changes. These can also become a valuable source for the capture of informal knowledge that already exists within the organisation.
- Develop a diffusion strategy for the introduction and adoption of ICT innovation. This should include:
 - Regular briefings that inform stakeholders as to the progress being made and proposed strategies to be implemented – this is especially important where head office and site offices are required to integrate processes.
 - Formal staff development programmes to support the introduction of new ICT
 - "Help desk" support, possibly hosted off-site by the chosen ICT provider
 - Recognition of on-site, unofficial "experts" who are regularly approached by their peers for support in solving problems.

Critical Success Factor 2: Organisational Commitment

An organisation's continuous and conspicuous investment in staff development and training is vital to its successful adoption and use of ICT.



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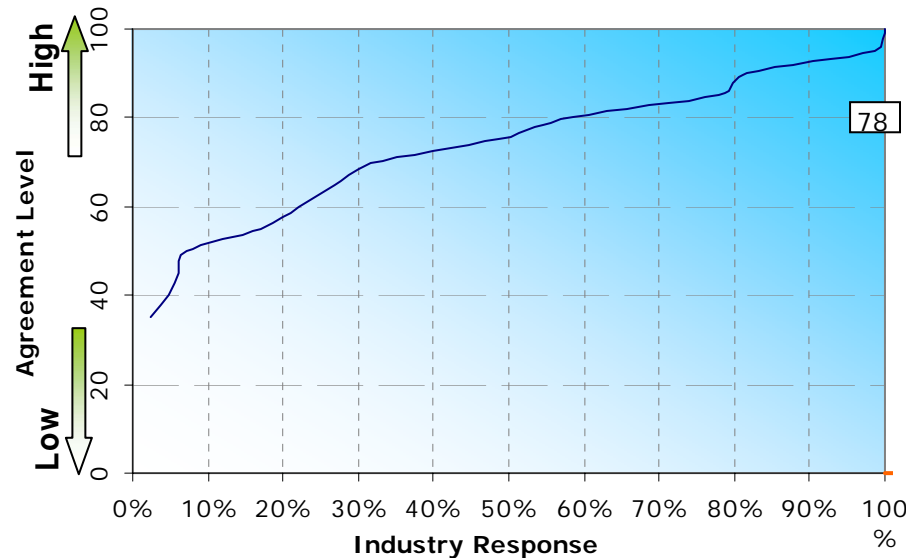
This factor has a close and symbiotic relationship with the previous factor. Comprehensive and ongoing staff development is a conspicuous demonstration of both the senior management's commitment to making ICT integration work, and to their staff as a vital and integral resource.

Action Statement

- Conduct needs analysis in conjunction with ICT provider.
- Roll out staff development programme tailored to these needs.
- Listen to staff feedback and be prepared to modify support and training provision in response to their perceived needs – often they will be the early indicators of problems that can be nipped in the bud through early intervention.
- Conduct periodic staff performance reviews with a view to identifying weaknesses and devise individual action programmes that overcome them.

Critical Success Factor 3: Organisational Commitment

Successful ICT implementation requires the commitment of a firm's senior management.



Best Practice Profile

High-level users will already have considerable experience with tools that both enable on-line project team collaboration and design within an electronically mediated environment. The decisions to engage with both of these technologies will be fully supported at board level and the implications in terms of productivity gains, competitive advantage and resourcing will be widely understood. Furthermore, this understanding will be communicated down throughout the firm's structure by the words and deeds of the senior management in terms of commitment to resourcing and re-engineering the business to align with the opportunities presented by the use of ICT.

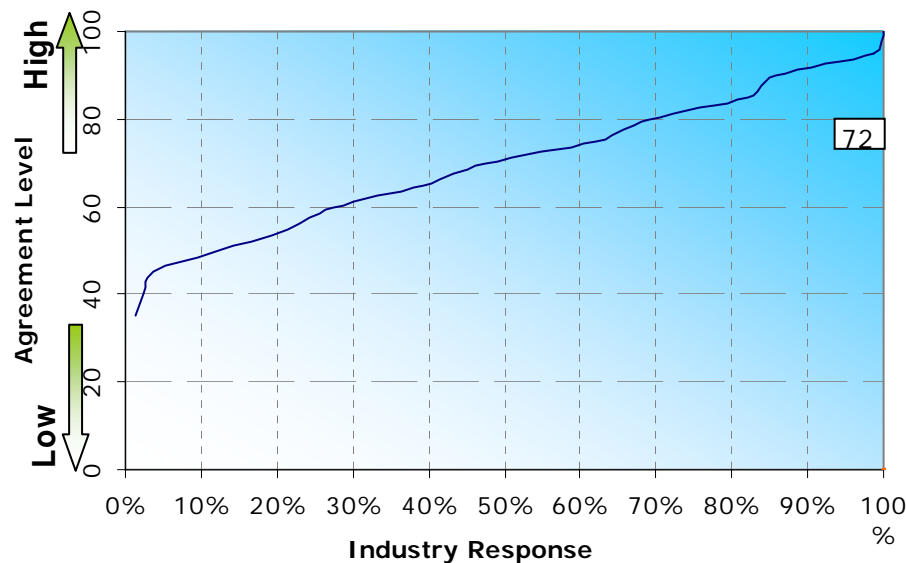
In many ways the issues confronting medium-level users are similar to those of a high-level user, except for the level of technology employed. It may well be that it is unnecessary to employ the most sophisticated technology *except* where trading partners demand it. Nevertheless, the enthusiasm of the management for the adoption and integration of ICT into the firm's business processes must be emphatically communicated to all levels of the organisation.

Action Statement

- Identify a "champion" at a sufficiently high level within the organisation as to leave the workforce in no doubt about the board's commitment to the innovation.
- Empower the "champion" through access to adequate resourcing and the visible support of the board – the availability of investment in technology and people is reassuring.
- Communication to all levels of the organisation. This should be clear and unambiguous, simultaneously informing the staff of the proposed new direction, and enlisting their active engagement with it.
 - This must be a two-way communication process that signals the management's desire to listen to feedback and act upon it where appropriate.

Critical Success Factor 4: Organisational Commitment

Transparency and trust among project team participants is vital for the successful adoption of ICT across a project team.



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As a potential 'champion' of supply chain integration proactive ICT users should attempt to lead by example, facilitating an environment within which clearly delineated boundaries exist, which are accompanied by unambiguous protocols and the attendant responsibilities. Their motivation in this regard should come from the prospect of fuller engagement with supply chain partners resulting in improved competitiveness and profitability.

For those who are unable to lead in their own right, successful engagement with a supply chain 'champion', and with others within this ICT-mediated environment can provide two opportunities. Firstly it can reveal different approaches to doing business. Secondly it can signal to others that you are capable of adapting/adopting different business processes, which in itself can lead to future collaborations on different projects.

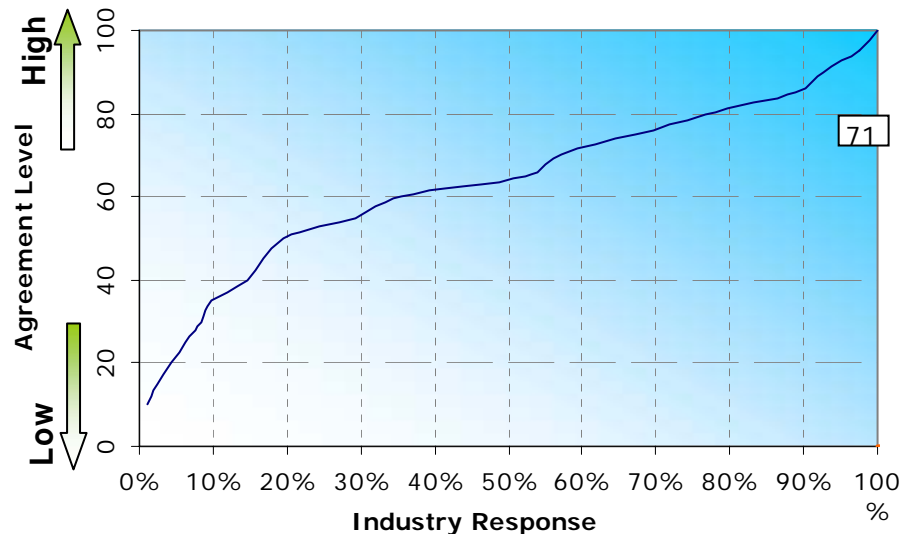
In either case, it is likely that a change in approach to dealing with project trading partners must be preceded by a corresponding, internal shift in corporate attitude that permeates all levels of the organisation.

Action Statement

- Identify those aspects of inter-firm business that are likely to be altered by the adoption of ICT and further identify their potential to foster suspicion and mistrust.
- Concurrently canvass internal opinion and experience as to the gap between current practice and ICT-enabled practice with a view to identifying any "cultural gap".
- Conduct risk analysis of proposed alternatives. Consider,
 - Impact on internal business processes
 - Impact on external business relationships and alignment of business processes
- Devise processes and protocols that will:
 - Facilitate business process alignment
 - Protect the business interests and confidentiality for users of your ICT-mediated project processes
 - Reassure all stakeholders

Critical Success Factor 5: Rights and Duties

The identification of the ownership of the intellectual property generated during a project is a significant issue affecting the adoption of ICT across a project team.



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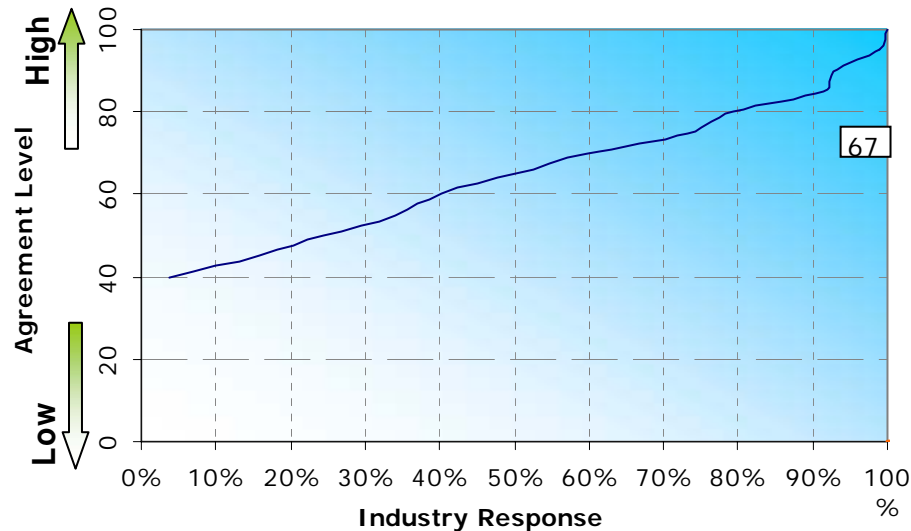
As a subcontractor you may have a high degree of sensitivity to this issue in the sense that you will be responsible for generating a significant proportion of the intellectual property for a project that relates to your area of speciality. Issues such as adequate reward for comprehensive documentation, ownership of data generated during a project, and post-completion knowledge management will to some extent pervade your thinking. You should also be sensitive to the possibility that data that you pass on to a third party might subsequently be used for purposes that you never intended. Issues of your responsibility/liability in this eventuality should be considered and actions reviewed in this light.

Action Statement

- Review the range of documentation that you might be contractually obliged to generate and share, and compare it to the full range of data that you could potentially distribute.
- For each example consider
 - The potential business opportunities that each one offers
 - The risks that come with each
 - Current practice
- Evaluate each one and formulate strategies that enable your firm to obtain maximum leverage whilst concurrently maintaining an acceptable level of control over your intellectual property. Consider
 - Immediate gains (monetary, goodwill)
 - Long-term advantage (strategic alignment)
 - Misuse by others of your intellectual property (misrepresentation by a third party, fraudulent re-use)

Critical Success Factor 6: Rights and Duties

Project team members must acknowledge the sensitivity and confidentiality of other participants' information.



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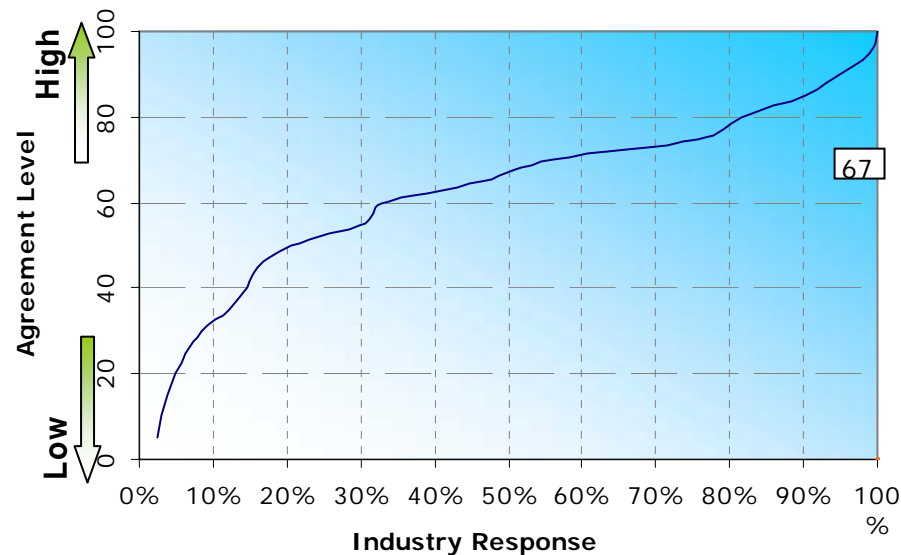
The growing prevalence of electronic tendering also raises issues of security and probity. Similarly, the knowledge that you have the potential to comprehensively generate and seamlessly distribute material that would be of interest and assistance to others in the project team will affect your attitude to forming and maintaining supply chain relationships – will you trust those who have demonstrated commitment to a long-term business relationship or do you regard trust an antecedent of commitment? Just as the previous factor asks you to look at the advantages and disadvantages of greater levels of shared information, this factor highlights your responsibilities as a recipient of valuable information.

Action Statement

- Identify the types of raw data and information that is generated by your project team partners.
- Evaluate each from the perspective of
 - Current practice for data generation and distribution
 - Possible advantages of receiving this electronically
 - Potential for information re-use, including consequences/limitations in terms of
 - Professional responsibility
 - Ethical standards
 - Liability/limitation of reliability assumed by your firm as a result
 - Cost/benefit analysis in terms of possible payment for additional data compared to competitive advantage obtained as a result.

Critical Success Factor 7: Rights and Duties

Project teams require a powerful ICT “champion” to support the technologically weaker organisations in order to ensure that communication processes continue to function as planned.



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As a subcontractor your ability to influence the technology choices and protocols within a project team may well be limited, with the ultimate decisions on these matters being taken further up the project supply chain by the client or head contractor. Nevertheless, ensuring that your project team partners adjacent to you in the supply chain are aware of your ICT capabilities may well enable you to ensure that these are utilised to the full and could determine choices for others within the project. Be prepared to support those further down the supply chain that might not have the technology or the skills capability to fully engage with your work practices. Consider forming strategic relationships with them in order to stabilise that part of your supply chain on successive projects.

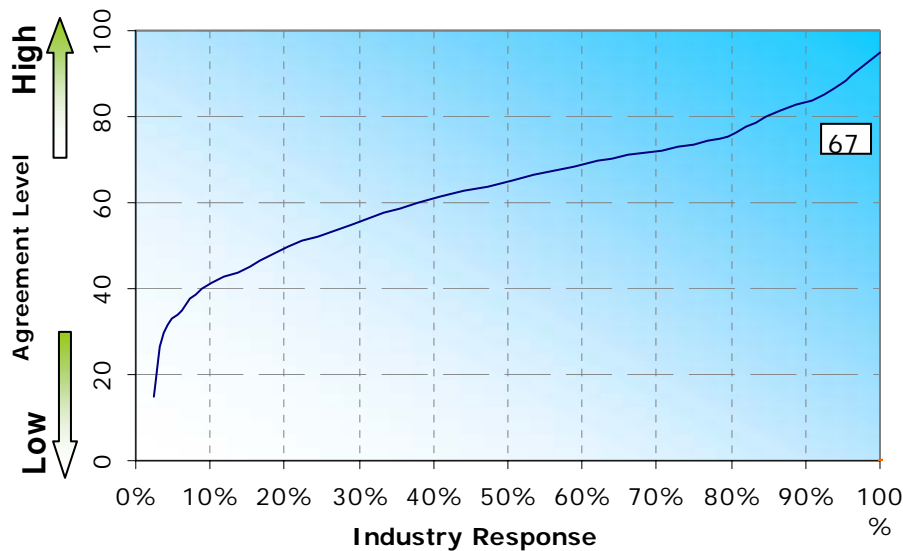
The issue for your firm will be one of unfamiliarity with a new work practice. You will already have developed the agility to adapt to other ICT-enabled work practices and the expectation that you embrace another shouldn't present too much of an obstacle. Leverage off the initiative sponsor's enthusiasm by engaging with it, demonstrating willingness whilst at the same time requesting as much assistance as possible. Remember that the larger the sponsor's investment in the ICT, the greater the pressure on them to make it work!

Action Statement

- Identify the extent to which you are able to influence the design of project supply chain communications protocols.
 - In the event that you are able to dictate them you should be prepared to support the engagement of others across the project in project-specific relationships.
 - If you are unable or unwilling to affect the entire chain you may well feel that commercial/competitive goals are best achieved by the formation of strategic relationships with your own supply chains over a number of projects.
- In either case, communicate your requirements very clearly to your trading partners, taking care to ascertain their current capabilities and critical shortfalls. Assess the costs and benefits of your chosen ICT strategy and be prepared to modify prior to implementation.
- Implementing support for trading partners can take a number of forms:
 - Use of third parties: vendor help desk, vendor on-site assistance, embedding your own staff within their organisations during the initial stages of implementation.
- Monitor feedback from your partners to determine the extent of technical progress and skills acquisition – modify support accordingly.

Critical Success Factor 8: Investment Drive

Organisations commit to ICT as a long-term, strategic decision.



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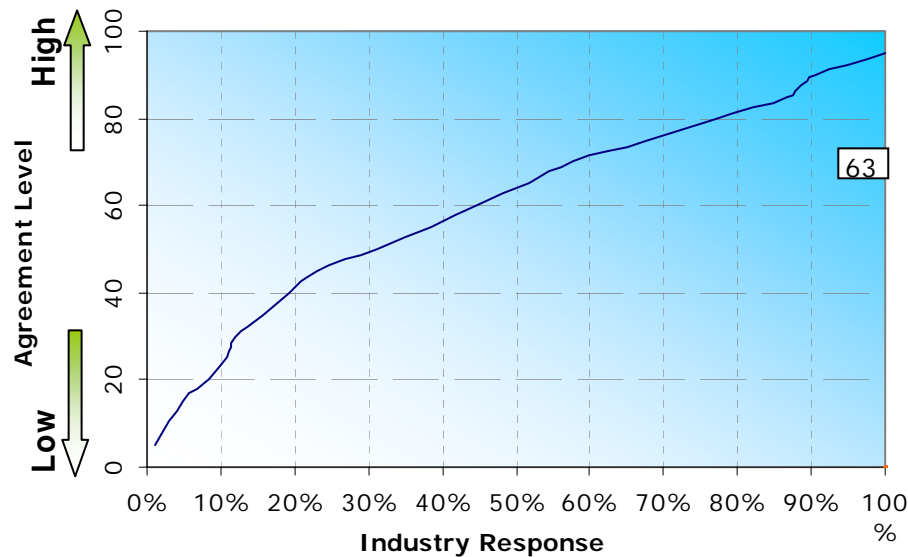
The wholesale integration of ICT into an organisation's business practice has always been the technocrat's utopian objective. Increasingly it is also becoming the logical conclusion of any high-level user's ICT strategy, and for this to become a reality at the highest level it requires a measure of inter-organisational alignment, and the consequent strategic focus that this brings. In any event, an organisation that wishes to engage with ICT has to take a long-term view of their related investments and not expect an immediate payback over, say, a single project. ICT adoption and integration can be undertaken as a strategic decision, in isolation from all other trading entities, and justified as such. But its identification as a business decision must occur as a result of strategic planning, as a clear goal in its own right, which may subsequently be linked to other goals as an enabler.

Action Plan

- Identify ICT adoption and integration as a tangible outcome of strategic planning, possibly as a goal in its own right, or as an enabler of other strategic goals e.g. strategic relationship formation, new product delivery, improved efficiency, targeted cost reduction, etc.
- Evaluate alternative options for cost, benefit and return on investment. Remember that experience has shown that the maximum benefits accrue over time and are often difficult to quantify - effectiveness and performance improvement are often experienced in a subjective way. Engaging external expertise at this point will prove advantageous for the majority of firms since they will be unlikely to possess sufficient in-house resources.
- Implement your chosen strategy, adhering to the principles of
 - Top down support
 - "Championing"
 - Adequate resourcing and staff development
 - Inclusive discussion and feedback
- Develop monitoring mechanisms that will allow you to constantly evaluate the true value obtained from your ICT investments.

Critical Success Factor 9: Investment Drive

Organisations commit to ICT as a project-based, tactical decision.



Best Practice Profile

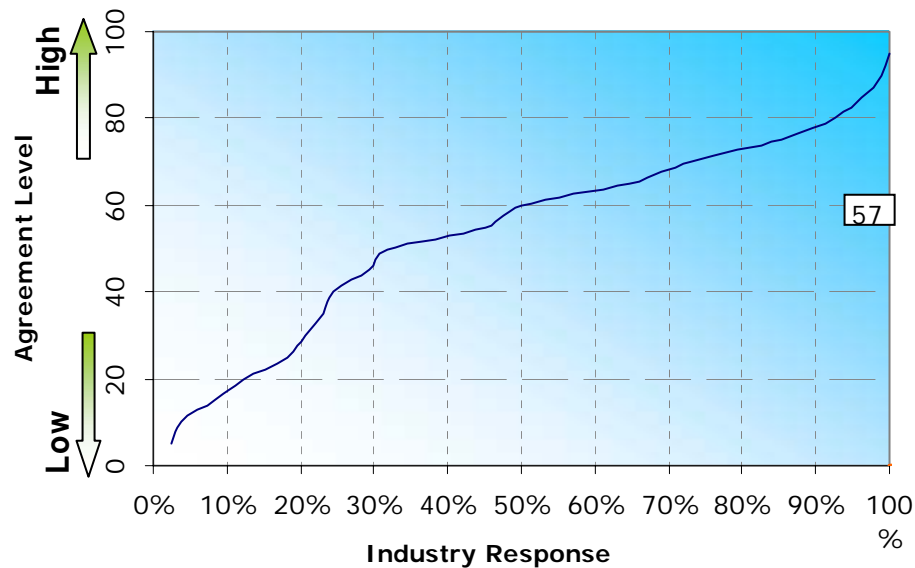
High-level users will have commitment to ICT as a cornerstone of their firm's business strategy. However, it is possible that client demand or an unusual project could entail the adoption of a technology for a one-off job. Issues to be addressed here would be the desirability of winning the work (either the project or the client), cost/benefit analysis including likelihood of recovering true cost of investment over the project term, and possibility that the availability of the technology and expertise might help win future work (competitive advantage). At lower levels of ICT use the same issues are relevant, but the cost/benefit analysis of the initial investment will probably be more critical in the sense that the capital/training costs will probably represent a higher proportion of anticipated profit on the project. These firms will be less likely to be in a position to actively ensure its use on future projects since their position in the supply chain would suggest that they have less "power" to dictate supply chain ICT protocols.

Action Plan

- Evaluate any external pressure to engage with an unfamiliar ICT-enabled process in terms of the following criteria:
 - Costs/drawbacks
 - Likelihood of recovering all associated investments within the project(s) duration
 - Effect of disruption to normal functioning entailed in adopting new ICT
 - Benefits
 - Possibility that demonstrable expertise in a particular ICT process will lead to future work with it's sponsor
 - Possibility that experience with ICT will trigger beneficial re-engineering within your firm beyond the scope of the present project(s).
- Ensure that evaluation encompasses *all* costs and benefits, both immediate and long-term.

Critical Success Factor 10: Investment Drive.

Competitor adoption is the most powerful trigger for the adoption of ICT.



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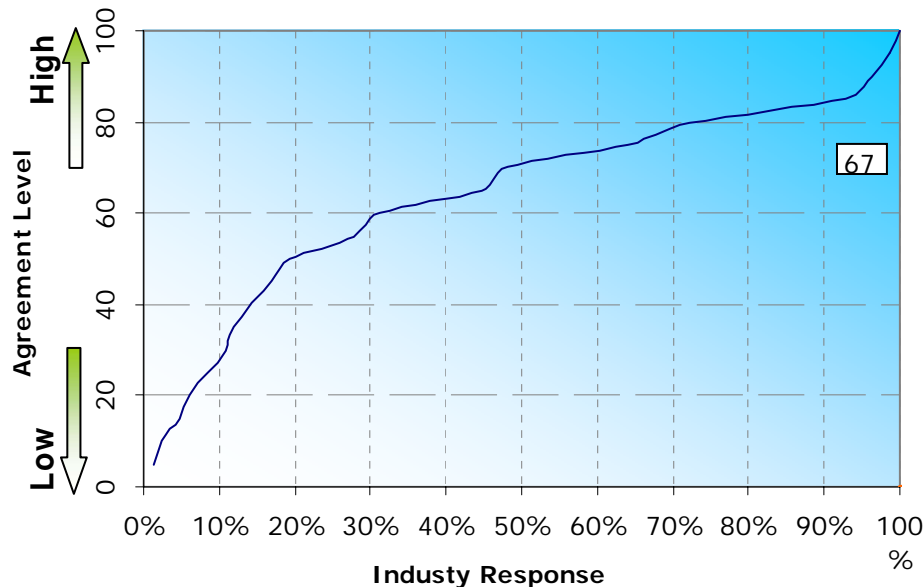
What was once innovative for a pioneer all-too-soon becomes an essential pre-requisite for their competitors. Differentiation can give competitive edge, alternatively, failure to keep up can mark the beginning of decline. The trick therefore is to combine market vigilance to ensure that you are able to provide what the competition is also supplying, with an awareness of the things that *they are not yet supplying*, with an aim to innovate. Implicit in this is the assumption that if you are a high-level ICT user you are more likely to be locked into more expensive, legacy technologies that require an evolutionary roll-out and upgrade. The cost of revolutionary change might therefore prove prohibitive and technology choices must be made with an eye to the future. For a medium-level user ICT, failure to keep abreast of current practice can quickly stand any firm in a position from which it may be difficult to recover. By definition your firm is more likely to have a greater number of competitors and therefore it may well prove impossible to align your practices with the entire market. By the same token the search for competitive edge may well be found in the early and/or innovative adoption of ICT to provide a solution to market needs.

Action Plan

- Routinely monitor competitor activity for unusual or extended service provision.
- Consider monitoring overseas practice for advance warning of trends.
- Develop an awareness of technological advances in other markets and consider how they might be adapted for use in your markets.
- Accept that a competitive advantage derived from innovative use of ICT is likely to be short-lived. If it is valuable to your customers then others will imitate your practices – if they don't then it is likely that your innovation is either extremely niche-oriented or an irrelevance in the marketplace.

Critical Success Factor 11: Communication Structure

A fragmented project team will lead to the ineffective performance of ICT-enabled operations.



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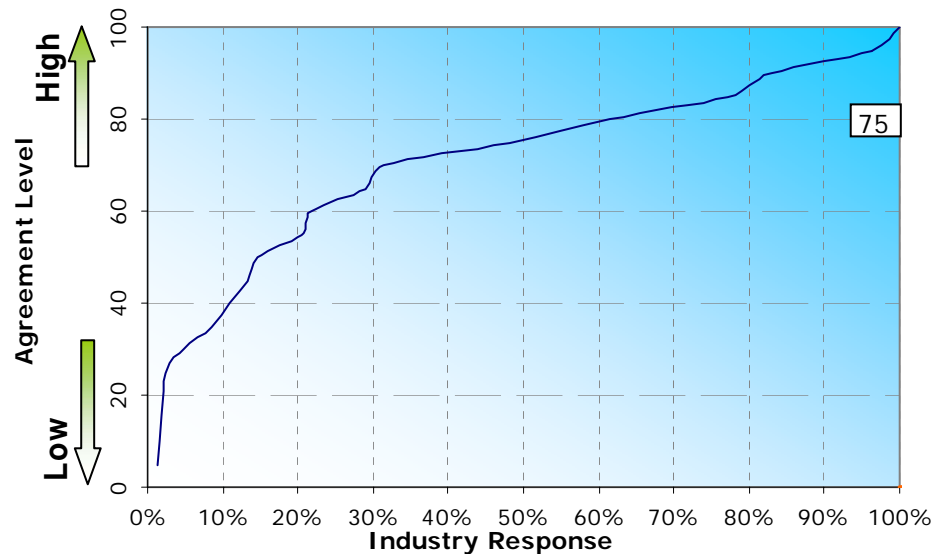
In order to obtain maximum benefit from your ICT investments it is crucial for your firm to minimise the fragmentation within those parts of the supply chain that you are able to influence. The construction industry does not, for a variety of reasons, lend itself to the formation of enduring business relationships. Nevertheless, they are possible, can be profitable, and tend to smooth the peaks and troughs in demand. Whilst ICT, of itself, won't lead to increased demand, the ability to operate at distance can make your firm more attractive if your reputation has attracted attention. This holds true for ICT users at all levels. Any kind of relationship and stability will allow for the investment of resources in ICT alignment in support of common business processes. Your ICT must be seen as an *enabler* of business, not an end in itself. With commitment from the project participants, ICT can bridge gulfs, be they geographical, business process or cultural.

Action Plan

- Assess
 - Your firm's readiness and ability to function in a project 'at distance'.
 - The willingness and capability of your project partners to engage electronically.
- Evaluate the possibility/desirability of encouraging closer ties with one/some of those partners that appear to share similar approaches to your firm in respect of on-line collaboration.
- Monitor the outcome of any decision to strategically align with one or more of your project partners for signs of beneficial performance improvements and potential problems, also for the likelihood of business relationships that might endure beyond the current project.

Critical Success Factor 12: Support and Assurance

The security of information is vital in an ICT-enabled project environment.



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As a subcontractor, the two-way communication of information can be a core business activity. It is reasonable to expect ICT to make this process more efficient. One way in which this can be facilitated is by allowing access to relevant files located on your intranet, or on a dedicated extranet. However, the very act of sharing in this way opens your business up to the possibility of unauthorised access, be it accidental or malicious. Various approaches can be taken to overcome these types of problem, some of which will involve expenditure on security systems such as encryption, password protected access, etc and others that will require a shift in the attitude of your staff and those that have access to your system to security issues.

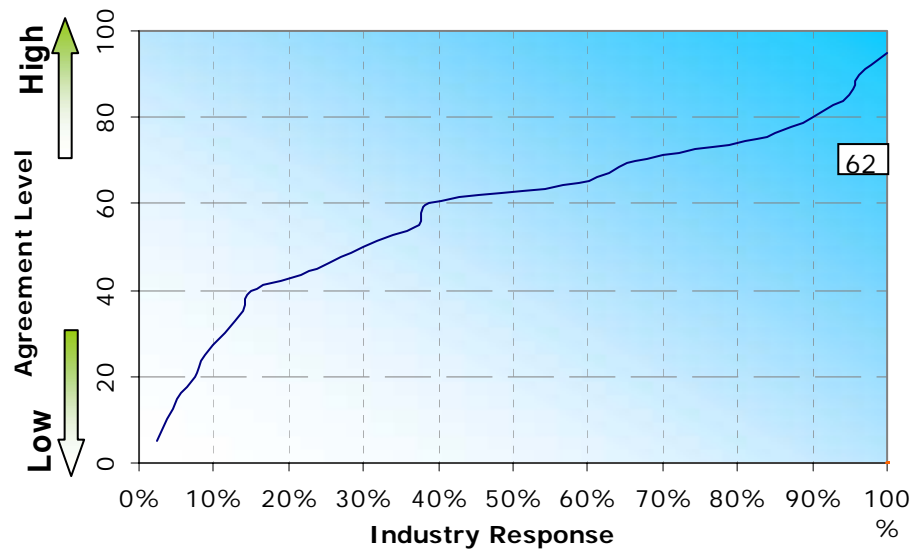
Another approach may be to choose to exchange all project-specific communication and data on a project web site, hosted by an application provider on a third party server. However this option is more commonly championed by a head contractor or client, and the issue of security for you will now become one of the levels of trust that you have in the level of integrity of the system in terms of unauthorised access.

Action Statement

- Identify the types of data exchange and communications that you would ideally like to undertake using ICT, considering issues such as
 - The need for confidentiality/commercial sensitivity
 - File size volume of traffic
 - Control over eventual use of data exchanged (i.e. what will the recipient do with your data?)
- Consider the domestic alternatives
 - Intranet
 - Extranet
 - Project web site
- Factor in the external influences. Is your business required to align its processes with those of its clients or project head contractors? If so, how will your in-house system interface with it? How will you protect it from unauthorised access?
- Be prepared to enlist external expertise to help design/provide the infrastructure that you decide upon.

Critical Success Factor 13: Support and Assurance

A “champion” should support all new technology that is to be used across a project team within a firm.



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Just as the use of ICT must be championed by a strong firm within the project team, so it is for ICT initiatives *within* the individual firm. An initiative that doesn't have senior management commitment will be unlikely to succeed. But this must be clearly identified with an individual who has both the belief in the initiative and the authority within the organisational structure to ensure that what needs to happen actually does. The identification of this champion is both a visible confirmation of the seriousness with which the senior management regard the initiative and a rallying point for those who have to operationalise the vision.

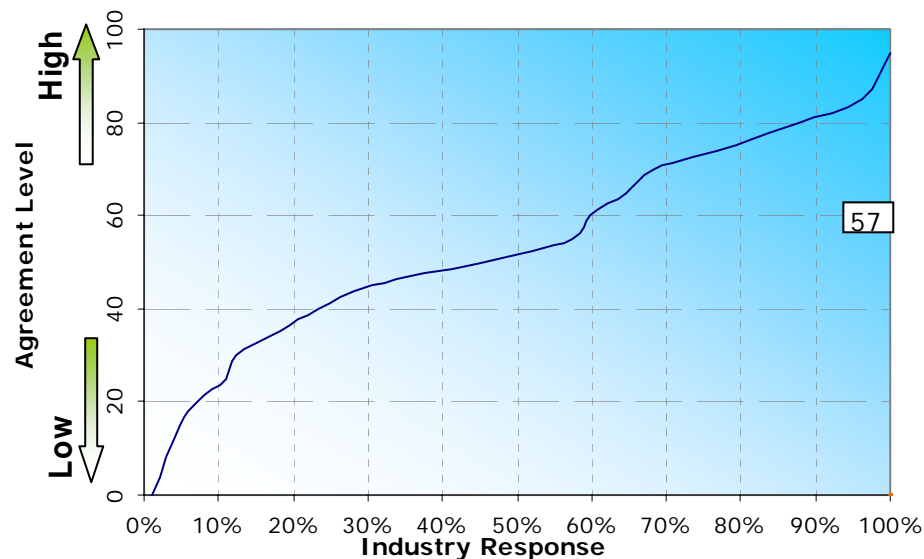
There is no significant difference in the issues facing a “champion” of a medium-level initiative except possibly in terms of the amount of investment riding on its success – high-level technologies tend to cost more! Conversely, lower-level initiatives may well permeate further through the firm and could involve diffusion to a wider user group. In addition, the selection of the “champion” and his/her visibility will be more obvious within a smaller organisation.

Action Statement

- Identify a willing, competent individual who has sufficient enthusiasm for the task. They should possess a well-rounded grasp of *all* aspects of the firm, not focus purely on technical issues – remember that ICT is an enabler, not a driver of business processes.
- Empower this individual publicly, with decision-making capacity and access to resources.
- Ensure that regular reports are forthcoming from the ICT team and that the direction that they indicate is sufficiently aligned with the rest of the firm's strategic goals.
- Conversely, ensure that messages of encouragement and/or caution are clearly communicated from senior management, especially where an ICT initiative is taking the firm into genuinely new territory.
- Constantly monitor and review the actions of the “champion” and their team so that board level support can be publicly seen to be unconditional.

Critical Success Factor 15: Organisational Attitude

When using ICT for project communications an organisation needs to be prepared to engage in long-term collaborative relationships, such as partnering.



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As an already-sophisticated adopter of ICT, who in all probability has integrated its use across all of your internal business processes, you will now largely be forced to look at integration with others in the supply chain in order to maximise leverage from your ICT investments. Implicit in taking this step are the elements of, (a) trust in your trading partners' ability to deliver and (b) commitment to making such a collaborative venture work. Although relatively common in supply chains in production-based industries, for this type of relationship to work in the construction industry requires both parties to believe that best value and best price are often very different, and that the former is a better business aim when it comes to customer satisfaction.

Medium-level users typically have the commitment to the concept of ICT integration with their business processes, but are confused as to the next level to which they can move. Usually smaller in size, their ability to influence project-wide ICT protocols is limited. As a result, their engagement is usually on an individual project basis. However, alignment of their business processes with a discrete group of suppliers can often prove attractive to head contractors and clients, since they effectively reduce the risk associated with marrying design and execution in their area of expertise.

Action Plan

- Assess the extent to which your firm's senior management is committed to the principle of strategic relationship formation and maintenance. This should be informed by the results of a SWOT analysis undertaken as part of the firm's strategic planning review, which should also clearly identify those other firms with which such a relationship is desired.
- Open dialogue with prospective partners with a view to establishing the current state of business process compatibility and ICT capability, with the aim of in-principle convergence of both. Negotiate strategies to this end.
- The implementation of joint ICT initiatives must be concurrently compatible with the individual business goals of the participants. It must also be driven by a "championing" partner, who is usually in a more powerful position relative to existing or potential project supply chains. Be aware of the consequential responsibilities that this role brings (see previous factor).

Barriers to ICT use: guidance for low-level users.

As a low-level ICT user you are most likely to be concerned about the cost of investing in new, more advanced technology. Three critical factors regarding the associated resource implications have been identified that require consideration in order to be overcome, namely,

- Initial investment cost,
- Staff development and training, and
- Sourcing appropriate external expertise.

There is also a raft of subsidiary factors that have been identified as being a source of confusion to new entrants to the ICT domain that require your consideration. They tend to either reinforce resourcing issues as a barrier or concern externalities such as the impact of ICT use on business relationships, and the associated cost/benefit equation.

Your objective should be to consider the extent to which each of the following barriers is relevant to your firm's business situation, and formulate strategies that help to overcome those barriers where your score is particularly high. This might require that you address a number of the related subsidiary factors.

Critical Barriers: Resource Implications

Research has shown that the low-level ICT user within the subcontracting sector of the construction industry is typically a smaller business with five or less staff, and has often existed for twenty years or more. When considering the possibility of adopting new technology three barriers are commonly cited:

- The high cost of new technology tends to discourage such investments.
- The resource implications of training staff on new technology discourage their implementation.
- It is difficult to find ICT advice (consultants) in the construction industry

From this it can be seen that the issues facing low-level ICT users are;

- Justifying the opportunity-cost of investment in new technologies when the identification and quantification of the derived benefits is problematic,
- Overcoming the inevitable gaps created in core business activity when releasing staff for essential staff development in the new technology, especially when the release of just one member of staff can mean a reduction of 20% in personnel, and,
- Identifying appropriate, flexible sources of expertise, prepared to advise on the firm's ICT requirements and deliver appropriate training.

Non-Critical Barriers

You should note that the industry participants listed the following points as issues that affected their willingness, or ability, to engage with ICT. We would caution that none was reported in sufficient number to become a critical barrier. However you may see links between some of them and the three critical barriers above. In any event, your objective should be to identify those that have a particular consonance with your own attitude then formulate strategies to overcome these negatives.

Trust

- A lack of trust in the security that new technology provides tends to discourage involvement.
- Confusion over the ownership of intellectual property generated during projects discourages new technology use for project communications.
- The culture of sharing and transparency inherent in the use of new technology is difficult to adjust to.

Finance

- New technology investments do not give a decent direct financial return.
- Low profit margins in the construction sector do not allow for investment in new technology
- The high rate of technology obsolescence is unattractive in terms of resource commitment required to remain abreast of new developments.

Risk

- Adoption of new technology for communication between project team members is considered risky since the contractual forms currently available are not tried and tested in this type of environment.
- The lack of common technology standards can make choosing/using new technology confusing.

Organisational Culture

- The drive to adopt new technology within many organisations is lacking.
- The business case to adopt new technology within many organisations is missing.
- There is no drive from project team members (contractors/consultants/ clients) to use new technology.

Action Statement

- Strategies for overcoming these barriers would, in the first instance centre on developing a more sophisticated business case for the inclusion of medium-level ICT into the firm's business activities. This should be regarded as the introduction of an innovation, not merely the acquisition of a new tool. This represents a key attitudinal shift, which recognises the new ICT investment as a *strategic* decision. The consequence of this is to educate both management and staff to expect the roll-out and integration phases to both be significant events *and* triggers for change. Return-on-investment would not therefore be expected to be immediate or project-related, although efficiency gains would become immediately apparent, especially in terms of printing and communication costs and times – “doing things better”. Rather, the move towards maximisation would occur over a period of time during which effectiveness gains would become apparent, typically being the result of the re-engineering of certain business processes – “doing better things”.
- The previous point deals with the issue of intra-firm adoption/integration. However the initial trigger for adoption of higher levels of ICT may well come from outside of your firm. The pressure to engage electronically with other project team members can be more persuasive than a conviction that ICT allows you to innovate. However, the list of non-critical barriers contains enough evidence that attitudinal change is required before your firm is likely to develop successful ICT-mediated engagement with other trading partners. Full benefit from on-line engagement is unlikely until you are convinced that the technical and legal measures available safeguard your business interests. Only the ability to trust these measures will allow you to fully commit to both the project and its communications channels. It should be noted that currently, technical security solutions are far in advance of legal developments specifically tailored to the advent of ICT-enabled contract communications. It follows that trust is mostly dependent upon the nature of the relationship between the two parties and that this is best initiated outside of an ICT-mediated environment i.e. in face-to-face meetings.
- Assistance related to engagement with the ICT protocols dictated by others can best be addressed by dialogue with the “champion” organisation. It is becoming increasingly common for them to either employ their own technical support staff (when they have developed in-house systems) or for their chosen application vendor to provide technical support (either on-site or via a telephone/email helpdesk). In the event that you decide to develop your ICT capability independently of any particular project, you should only make technology decisions after a comprehensive SWOT analysis that identifies both your firm's internal readiness and capability, and the external opportunities offered by each of the technologies under consideration.
- Now read the success factor sheets for medium- and high-level ICT users to understand more clearly the implications of the decisions that you are about to make.